

What is Claimed is:

1. A radio communication apparatus comprising:

a first antenna;

a first transmitting apparatus of outputting a transmitting signal in a first frequency band;

a first duplexer, connected to said first antenna and having a single-phase input terminal and a balanced output terminal, of conveying said transmitting signal inputted to said single-phase input terminal to said first antenna and outputting a receiving signal in a second frequency band different from said first frequency band received from said first antenna substantially as a differential signal from said balanced output terminal; and

a first receiving apparatus connected to said balanced output terminal and having a circuit in which a gain of a signal of a differential component is higher than that of a signal of an in-phase component, or a loss of the signal of the differential component is lower than that of the signal of the in-phase component.

2. The radio communication apparatus according to claim 1, wherein said first duplexer has a first phase shifter, a second phase shifter, a third phase shifter, a fourth phase shifter, a fifth phase shifter and a sixth phase shifter;

said first antenna is connected to said first phase shifter and said second phase shifter;

said first receiving apparatus is connected to said first phase shifter and said second phase shifter via said third phase shifter and said fourth phase shifter respectively;

said first transmitting apparatus is connected to said first phase shifter and said second phase shifter via said fifth phase shifter and said sixth phase shifter respectively;

said third phase shifter and said fourth phase shifter are connected to said fifth phase shifter and said sixth phase shifter respectively;

a difference in a phase shifting amount between said first phase shifter and said second phase shifter is substantially 90 degrees;

the difference in the phase shifting amount between said third phase shifter and said fourth phase shifter is substantially 90 degrees; and

the difference in the phase shifting amount between said fifth phase shifter and said sixth phase shifter is substantially - 90 degrees.

3. A first duplexer comprising a single-phase input terminal connected to a first transmitting apparatus and a balanced output terminal connected to a first receiving apparatus, wherein:

said first transmitting apparatus outputs a transmitting signal in a first frequency band; conveys said transmitting signal inputted to said single-phase input terminal to said first antenna and outputs a receiving signal in a second frequency band different from said first frequency band received from said first antenna substantially as a differential signal to said balanced output terminal; and

said first receiving apparatus has a circuit in which a gain of a signal of a differential component is higher than that of a signal of an in-phase component, or a loss of the signal of the differential component is lower than that of the signal of the in-phase component.

4. An antenna apparatus comprising:

a second antenna having a first feeding point of feeding a receiving signal and also having two or more polarized waves; and

a third antenna placed along with said second antenna and having a second feeding point of feeding the receiving signal and also having two or more polarized waves, wherein:

said first feeding point is placed substantially on an exciting direction side of the receiving signal of said second antenna; and

said second feeding point is placed substantially on an opposite side to the exciting direction of the receiving signal of said third antenna.

5. The antenna apparatus according to claim 4, wherein said second antenna has a third feeding point of feeding a transmitting signal;

said third antenna has a fourth feeding point of feeding a transmitting signal;

said third feeding point is placed substantially on an opposite side to the exciting direction of the transmitting signal of said second antenna; and

said fourth feeding point is placed substantially on the opposite side to the exciting direction of the transmitting signal of said third antenna.

6. A radio communication apparatus comprising:

a second transmitting apparatus of outputting a transmitting signal;

the antenna apparatus according to claim 5;

a second duplexer, connected to said second antenna and said third antenna and having a single-phase input terminal and a balanced output terminal, of conveying said transmitting signal inputted to said single-phase input terminal to said second antenna and said third antenna and outputting a

receiving signal received by said second antenna and said third antenna from said balanced output terminal; and

a first receiving apparatus connected to said balanced output terminal and having a circuit in which a gain of a signal of a differential component is higher than that of a signal of an in-phase component, or a loss of the signal of the differential component is lower than that of the signal of the in-phase component.

7. A radio communication apparatus comprising:

a first antenna;

a third transmitting apparatus of outputting a transmitting signal as a differential signal;

a third duplexer, connected to said first antenna and having a balanced input terminal and a single-phase output terminal, of conveying said transmitting signal inputted to said balanced input terminal as a single-phase signal to said first antenna and outputting a single-phase receiving signal received by said first antenna to said single-phase output terminal; and

a second receiving apparatus connected to said single-phase output terminal.

8. The radio communication apparatus according to claim 7, wherein said third duplexer has a seventh phase shifter, an

eighth phase shifter, a ninth phase shifter, a tenth phase shifter, an eleventh phase shifter and a twelfth phase shifter;

said first antenna is connected to said seventh phase shifter and said eighth phase shifter;

said second receiving apparatus is connected to said seventh phase shifter and said eighth phase shifter via said ninth phase shifter and said tenth phase shifter respectively;

said third transmitting apparatus is connected to said seventh phase shifter and said eighth phase shifter via said eleventh phase shifter and said twelfth phase shifter respectively;

said ninth phase shifter and said tenth phase shifter are connected to said eleventh phase shifter and said twelfth phase shifter respectively;

a difference in a phase shifting amount between said seventh phase shifter and said eighth phase shifter is substantially - 90 degrees;

the difference in the phase shifting amount between said ninth phase shifter and said tenth phase shifter is substantially 90 degrees;

the difference in the phase shifting amount between said eleventh phase shifter and said twelfth phase shifter is substantially - 90 degrees.

9. A radio communication apparatus comprising:

fourth and fifth antennas;

a third transmitting apparatus of outputting a transmitting signal as a differential signal;

a fourth duplexer, connected to said fourth antenna and said fifth antenna and having a balanced input terminal and a single-phase output terminal, of conveying said transmitting signal inputted to said balanced input terminal to said fourth antenna and said fifth antenna and outputting a receiving signal received by said fourth antenna and said fifth antenna as a single-phase signal to said single-phase output terminal; and

a second receiving apparatus connected to said single-phase output terminal, and wherein said fourth and fifth antennas are formed and placed to radiate said transmitting signal substantially as the differential signal and convey said receiving signal substantially as an in-phase signal to said fourth duplexer.

10. The radio communication apparatus according to claim 9, wherein said fourth and fifth antennas are formed and placed to convey said receiving signal as the differential signal to said third duplexer instead of being formed and placed to convey said receiving signal as an in-phase signal to said fourth duplexer; and

said fourth duplexer converts said receiving signal inputted as the differential signal into the in-phase signal and outputs it as the single-phase signal to said single-phase output terminal.

11. A radio communication apparatus comprising:

sixth and seventh antennas;

a third transmitting apparatus of outputting a transmitting signal as a differential signal;

a fifth duplexer, connected to said sixth antenna and said seventh antenna and having a balanced input terminal and a balanced output terminal, of conveying said transmitting signal inputted to said balanced input terminal to said sixth antenna and said seventh antenna and outputting a receiving signal received by said sixth antenna and said seventh antenna as the differential signal to said balanced output terminal, and outputting a part of said transmitting signal substantially as an in-phase signal to said balanced output terminal; and

a first receiving apparatus connected to said balanced output terminal and having a circuit in which a gain of a signal of a differential component is higher than that of a signal of an in-phase component, or a loss of the signal of the differential component is lower than that of the signal of the in-phase component.

12. The radio communication apparatus according to claim 11, wherein said fifth duplexer has a thirteenth phase shifter, a fourteenth phase shifter, a fifteenth phase shifter, a sixteenth phase shifter, a seventeenth phase shifter and an eighteenth phase shifter;

said sixth antenna and said seventh antenna are connected to said thirteenth phase shifter and said fourteenth phase shifter respectively;

said first receiving apparatus is connected to said thirteenth phase shifter and said fourteenth phase shifter via said fifteenth phase shifter and said sixteenth phase shifter respectively;

said third transmitting apparatus is connected to said thirteenth phase shifter and said fourteenth phase shifter via said seventeenth phase shifter and said eighteenth phase shifter respectively;

said fifteenth phase shifter and said sixteenth phase shifter are connected to said seventeenth phase shifter and said eighteenth phase shifter respectively;

a difference in a phase shifting amount between said thirteenth phase shifter and said fourteenth phase shifter is substantially - 90 degrees;

the difference in the phase shifting amount between said fifteenth phase shifter and said sixteenth phase shifter is substantially 90 degrees; and

the difference in the phase shifting amount between said seventeenth phase shifter and said eighteenth phase shifter is substantially 90 degrees.

13. The radio communication apparatus according to any one of claims 1, 6, 11 and 12, wherein said first receiving apparatus has an amplifier in which the gain of the signal of the differential component is higher than that of the signal of the in-phase component.

14. The radio communication apparatus according to any one of claims 1, 6, 11 and 12, wherein said first receiving apparatus has a filter in which the loss of the differential signal is lower than that of the signal of the in-phase component.

15. The radio communication apparatus according to claim 13, wherein said first receiving apparatus has a down mixer of down-converting said receiving signal being connected to a subsequent stage to said amplifier; and

said down mixer has the gain of the differential signal higher than that of the signal of the in-phase component or the loss of the differential signal lower than that of the signal of the in-phase component.

16. The radio communication apparatus according to claim 15, having:

a first transistor of having one of the receiving signals as said differential signals inputted to a base side thereof; and

a second transistor of having the other of the receiving signals as said differential signals inputted to the base side thereof, and wherein:

an emitter side of said first transistor is connected to an emitter side of said second transistor; and

a connection point thereof is connected to a ground via a first inductor having a predetermined inductance.

17. A radio communication apparatus comprising:

a second transmitting apparatus of outputting a transmitting signal;

an antenna apparatus;

a sixth duplexer, connected to said antenna apparatus and having a single-phase input terminal and a balanced output terminal, of conveying said transmitting signal inputted to said single-phase input terminal to said antenna apparatus and outputting a receiving signal received by said antenna apparatus from said balanced output terminal; and wherein:

said sixth duplexer has an impedance for a differential signal in a frequency band of said receiving signal higher

than the impedance for a single-phase signal in the frequency band of said transmitting signal.

18. The radio communication apparatus according to claim 17, wherein said sixth duplexer does not substantially pass the differential signal in the frequency band of said receiving signal but passes the single-phase signal in the frequency band of said transmitting signal substantially without a loss.

19. The radio communication apparatus according to claim 18, wherein said sixth duplexer has two $1/4$ wavelength lines having length of substantially $1/4$ of the wavelength of the frequency band of said receiving signal, and said single-phase signal is conveyed to one side of each of said $1/4$ wavelength lines and said antenna apparatus is connected to the other side of each of said $1/4$ wavelength lines.

20. The radio communication apparatus according to claim 17, wherein said sixth duplexer has a parallel resonance circuit to which said single-phase signal is conveyed at a middle point of the impedance thereof, and said parallel resonance circuit resonates in the frequency band of said receiving signal.

21. A radio communication method comprising the steps of:

conveying to a first antenna a transmitting signal in a first frequency band inputted to a single-phase input terminal of a first duplexer;

outputting a receiving signal in a second frequency band different from said first frequency band received from said first antenna substantially as a differential signal from a balanced output terminal of said first duplexer; and

as to said receiving signal substantially outputted as the differential signal, rendering a gain of a signal of a differential component higher than that of a signal of an in-phase component, or rendering a loss of the signal of the differential component lower than that of the signal of the in-phase component.